

## Enhancing Software Testing with Genetic Algorithm and Binary Search: Integrating Error Classification and Debugging Through Clustering

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### **Abstract:**

This paper improves the Binary Search Genetic Algorithm (BSGA) [1] for software testing by combining error classification and debugging through k-means clustering. The extended BSGA approach optimizes test-case generation, it improves method coverage, and makes their quality imperfect streamlines debugging by categorizing them into groups on the basis. This allows for more effective fault localization, identifies the most likely causes of failure, and provides actionable debugging insights. Experimental results show that the proposed approach increases the method coverage by 94% comparing with 88% by BSGA, reduces the number of test cases by 13%, reduces the debugging time by 44%, and in addition, the error classification and the integration of fault location methods reduces testing costs and makes faults a faster system. The approach shows significant improvements in testing efficiency, provides a comprehensive solution that integrates test case generation, bug classification, and bug fixing, and ultimately increases the effectiveness of the software testing process.

### **Keywords:**

Test Case Optimization, Error Classification, K-Means Clustering, Software Debugging Techniques.